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COMPLETE SPECIFICATION

An Actuating Mechanism for Electric Circuit Breakers

We, ELEKTRO-MECHANIK-G.M.B.H., of Wendenerhütte über Olpe/Westfalen, Germany, a German Company, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

The present invention relates to electric circuit breakers particularly of high current carrying capacity, and the invention is concerned with the design and arrangement of the actuating mechanism with which such circuit breakers are usually equipped.

Circuit breakers of the kind mentioned must be capable of interrupting the current in the shortest possible time, in the case of a fault for instance. The arrangement is usually made such that a spring is tensioned when the circuit breaker is moved into its closed position and that the circuit breaker is held in this position by a lock device; by tripping the lock, the spring is released and effects a quick opening of the circuit breaker, i.e. a quick interruption of the current.

A conventional arrangement of this kind is shown in Fig. 1 of the accompanying drawings. A circuit breaker 11 is mounted on a frame 10. A sleeve 12 projects upwards from the top of the breaker casing; it accommodates a movable rod which carries the movable contact (not shown) of the circuit breaker. The sleeve has a longitudinal slot through which projects a pin 31 of the movable contact rod. The pin 31 is linked to an actuating lever 32 which is fast on a shaft 23 rotatably supported in the frame 10. Each time it is desired to close the circuit breaker, the shaft 23 and the lever 32 have to be turned in an anti-clockwise direction, if the device is viewed as shown in Fig. 1. Likewise rigidly connected to the shaft 23 is a lever 34. A strong spring 15 is connected to its free end, the other end of the spring may be anchored on the frame 10. It will be seen, that this spring is tensioned when the actuating lever is caused to move in an anti-clockwise direction to close the breaker, and the spring, when released, will rotate the shaft 23 and the actuating lever 32 in a clockwise direction to lift the pin 31 and to open the circuit breaker. A dashpot 14 is operationally connected to the shaft 23 to prevent shocks from occurring during the switching actions. For turning the actuating lever 32 into its closed position, a motor drive is provided, which comprises a motor 19, a worm-gear 35, a clutch 18, a transmission linkage 17, 16 and 36 and a ratchet wheel device 13. The ratchet wheel device comprises two wheels, the one which is seen is mounted free to rotate on the shaft 23, whilst a second smaller wheel (which is obscured by the larger wheel shown) is provided with the ratchet-wheel teeth and is rigidly connected to the shaft 23. The larger wheel carries a pawl (not visible) which engages the teeth of the smaller wheel, and the larger wheel is provided at the side shown with a pin 37 which is linked to the rod 36 of the transmission linkage. Thus when the motor 19 is started and the rod 36 is caused to move downwards as a result, the larger wheel of the pawl-and-ratchet device will be turned in an anti-clockwise direction, and due to the engagement between the pawl and the smaller toothed wheel, the latter will follow the mentioned rotary movement and thereby turn the shaft 23 to close the circuit breaker. The pawl is operationally connected with a trippping device (not shown) which is adapted to cause the pawl to release the smaller wheel of the ratchet device and therefore to open the circuit breaker. The larger wheel of the ratchet device and the transmission linkage remain in their position during the opening movement of the circuit breaker.

It has been found, however, that arrangements of the kind hereinbefore described are not reliable in service. Locks formed by a pawl and ratchet have a short useful life. Particularly the pawls are subjected to considerable wear, and after about 1000 operations a satisfactory and reliable engagement can no longer be expected. And a fault at the pawl lock prevents a closing of the circuit breaker even

[*Price 3s. 6d.*]

if an emergency device is provided for this purpose. Another disadvantage is to be seen in this: When the pawl releases the shaft 23 and this shaft is rotated by the action of the spring 15, the transmission linkage remains in the actuated position, and it is necessary by reversing the motor 19 to return the linkage into its initial position, shown in Fig. 1, to be ready for the next closing action.

It is the object of the present invention to overcome the indicated difficulties. To this end, an actuating mechanism for power operated electric circuit breakers which are provided with a spring device which is tensioned when the breaker contacts are closed and which opens the breaker contacts when released, is characterised in that it comprises a driving motor which through a transmission causes the circuit breaker to close, and in that the transmission includes a self-locking member and between this member and the actuated member of the breaker an electrically controllable clutch, the energising circuit of which is intended to be connected to a tripping device so as to release the said spring by de-energising the clutch. Thus the pawl-and-ratchet device is replaced by an electrically operated clutch. If a magnetic powder clutch is used, difficulties due to wear are practically avoided, and since the transmission members between the clutch and the actuating member of the circuit breaker take part in the opening movement effected by the spring device the actuating mechanism is ready for a closing action immediately after the circuit breaker has been opened.

In order that the invention may be clearly understood, an embodiment thereof will now be described in more detail with reference to Fig. 2 of the accompanying drawing.

The mounting of the circuit breaker is effected in the same way as in Fig. 1. The circuit breaker 21 is supported by a frame 20; it has a sleeve 22 which accommodates the contact rod which has a pin 31 actuated by a lever 32 which is fast on a shaft 23 rotatably supported in the frame 20. A spring 24 serves for rotating the shaft 23 to open the circuit breaker. But differing from the arrangement of Fig. 1, instead of a pawl lock, a lever 25 is rigidly connected to the shaft 23, which lever is operationally connected, for instance by a tie-rod 26, to another lever 28 which is connected to the output shaft of an electrically operated clutch 27, for instance a magnetic powder clutch. The input shaft of the clutch is driven through a self-locking worm gear 29 from an electric motor 30. The energising circuit of the clutch is connected to a tripping mechanism, not shown.

The closing of the circuit breaker 21 is effected in such a manner that the motor 30 is switched on while the magnetic powder clutch is energised, or the energising of the clutch is effected simultaneously with the starting of the motor. The magnetic powder clutch 27 transmits the rotary movement of the motor 30 through the connecting rod 26 to the actuating shaft 23 for the circuit breaker and causes thus the latter to close. When the circuit breaker 21 reaches its end position, and if a magnetic powder clutch is used, the clutch is able to slip, and from this slipping action the actuation of a switch may be derived to disconnect the current supply to the motor 30. As long as it is intended to maintain the circuit breaker 21 in its closed position, the clutch 27 remains energised. A return movement of the breaker 21 under the influence of the opening spring 24 into its open position is not possible, because the self-locking worm-drive 29 prevents such a movement from occurring. Only when the tripping device de-energises the clutch 27 to release its output member, is it possible for the breaker to return into its open position under the action of the opening spring. From this position the breaker can be closed at any time by a new energisation of the clutch 27 and by a simultaneous starting of the motor 30.

It is an advantage of the arrangement of an electrically controllable clutch that such a clutch may have a small electric time constant and that it can be so designed that its output member has a small inertia. If it is desired to adjust the electric time constant $T = \frac{L}{R}$ by varying the resistance R, e.g. in order to adapt the breaker for a quick opening movement, then it is advantageous to use an adjustable series resistance in the energising circuit of the electric clutch, due to the fact that with a reduced energising current the energising field, is reduced and by an increase of R a quicker disconnecting action is ensured.

Whilst with constructions known hitherto comprising a pawl-lock, it was necessary to mount the latter directly on the circuit breaker in order to obtain a mechanical release of the circuit breaker, the actuating mechanism for circuit breakers according to the invention makes it possible to locate the clutch which initiates the breaker movement at a more convenient point, e.g. remote from the switch and to connect it through a linkage with the circuit breaker, due to the fact that it is only necessary for the tripping device to interrupt the energising current if e.g. a magnetic powder clutch is used. Since all the actuating members of the transmission between the clutch and the breaker return into their initial position, when the breaker opens under the action of its spring device, all these members are ready for the next closing action and a reverse drive is not required. Moreover, with the new drive it is no longer necessary to disconnect the driving device at an accurate moment when the circuit breaker has reached its end posi-

tion, since the driving member of the clutch is able to slip with respect to the driven member without any danger. From this slipping action the stopping of the driving motor may be derived, as mentioned hereinbefore. If it is required to effect a great number of switching operations in quick succession, the driving motor need not be disconnected.

If switching means are provided to re-energise the clutch shortly before the completion of the opening movement of the circuit breaker and if for instance a magnetic powder clutch is used, then the clutch effects a braking and damping of the breaker movement so that the oil dash-pot required hitherto can be omitted. In order to provide the possibility of closing the circuit breaker in the case the driving motor fails, it is advantageous to provide the output member of the clutch with a hand-operated actuating device, e.g. a hand-wheel, a hand-lever, or the like, by means of which the circuit breaker can be closed. After the circuit breaker has been moved into the closed position while the clutch was disengaged, the circuit breaker can be held in the new position by simply energising the clutch. In order to be able to operate the circuit breaker by hand and to hold it in its position also in the case that the clutch becomes defective, a ratchet-and-pawl locking device may be additionally provided, adapted to be operated by an emergency hand drive, which allows the holding of the circuit breaker.

Since the clutch requires the supply of an electric current to maintain the circuit breaker in its closed position, it may happen that the clutch starts to slip if a voltage drop occurs. This could produce a slow parting movement of the breaker contacts, and an arc would be set up at the contacts. In order to prevent this from occurring, it is advantageous to provide an end contact, i.e. a contact which disconnects the clutch when the clutch starts to slip and quickly releases the circuit breaker.

In the case of magnetic powder clutches, instead of an interruption of the energising current, it is also possible to cancel this current by the connection of a voltage of opposite sign.

WHAT WE CLAIM IS:—

1. An actuating mechanism for power operated electric circuit breakers which are provided with a spring device which is tensioned when the breaker contacts are closed and which opens the breaker contacts when released, characterised in that the actuating mechanism comprises a driving motor which through a transmission causes the circuit breaker to close, and that the transmission includes a self-locking member and between this member and the actuated member of the breaker an electrically controllable clutch, the energising circuit of which is intended to be connected to a tripping device so as to release the said spring by de-energising the clutch.

2. An actuating mechanism according to claim 1, wherein the electrically controllable clutch is a magnetic powder clutch.

3. An actuating mechanism according to claim 1 or 2, wherein the said self-locking member is formed by a worm gearing.

4. An actuating mechanism according to any of the preceding claims, wherein the clutch is associated with a switch for disconnecting the current supply to the electric driving motor when a slip occurs between the members of the clutch.

5. An actuating mechanism according to any of the preceding claims, wherein switching means are provided to re-energise the clutch, after it has been de-energised for releasing the spring device, just before the parting contacts of the breaker reach their end position.

6. An actuating mechanism according to any of the preceding claims, wherein the output member of the clutch is provided with an additional hand operated emergency drive.

7. An actuating mechanism according to claim 6, wherein the hand operated drive is associated with a ratchet-and-pawl locking device for holding the actuating mechanism in its open position.

8. An actuating mechanism according to any of the preceding claims, wherein an adjustable resistance is inserted in the energising circuit of the electric clutch for adjusting the time constant of the latter.

9. An actuating mechanism according to any of the preceding claims, wherein the clutch is associated with an end contact which disconnects the clutch if the latter starts to slip.

10. An actuating mechanism according to any of the preceding claims 2 to 8, incorporating a magnetic powder clutch, wherein the de-energisation of the clutch is effected by connecting a voltage of opposite sign to cancel the energising current.

11. An actuating mechanism for electric circuit breakers substantially as described with reference to and as illustrated in Fig. 2 of the accompanying drawings.

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808,125 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

Fig.1

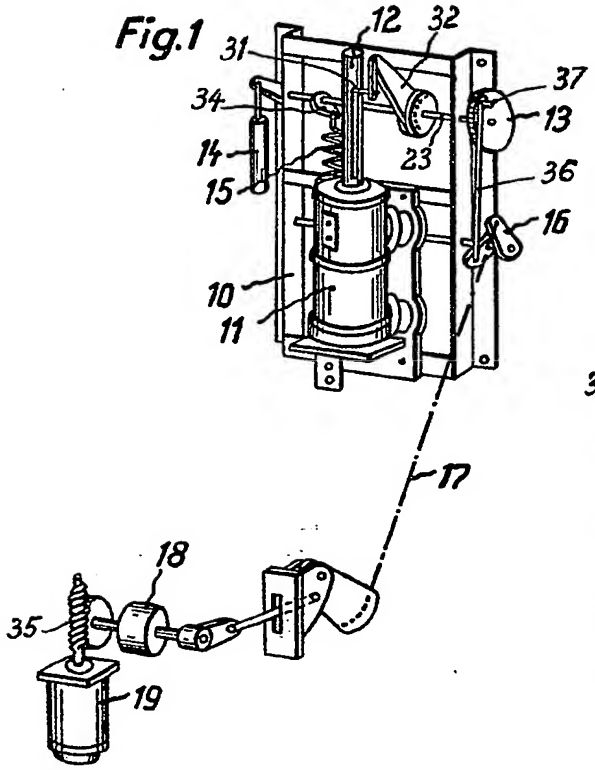

Fig.2